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Ozawa et al.

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(54) **COOLING STRUCTURE AND COOLING METHOD FOR ELECTRONIC EQUIPMENT**

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Related U.S. Application Data

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(51) **Int. Cl.**
F24F 7/00 (2006.01)
F25D 23/12 (2006.01)
H05K 7/20 (2006.01)

(52) **U.S. Cl.** **236/49.3**; 62/259.2; 361/688; 361/695

(58) **Field of Classification Search** 236/49.3; 62/259.2; 361/687, 695, 688, 689, 676, 724, 361/728
See application file for complete search history.

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(57) **ABSTRACT**

A cooling structure for electronic equipment including a plurality of electronic devices superposed on each other, each of the electronic devices having a lower part where an air ventilation part configured to ventilate air so as to cool the electronic device is provided, the cooling structure includes an air intake and exhaust hole forming part which is formed at an upper part of a first one of the electronic devices and below the air ventilation part of a second one of the electronic devices provided on the first electronic device. Air outside of the electronic equipment is taken into an inside of the second electronic device or air inside of the first electronic device is exhausted to the outside of the electronic equipment via the air intake and exhaust hole forming part, so that an amount of the air ventilated inside of the first electronic device is controlled.

12 Claims, 11 Drawing Sheets

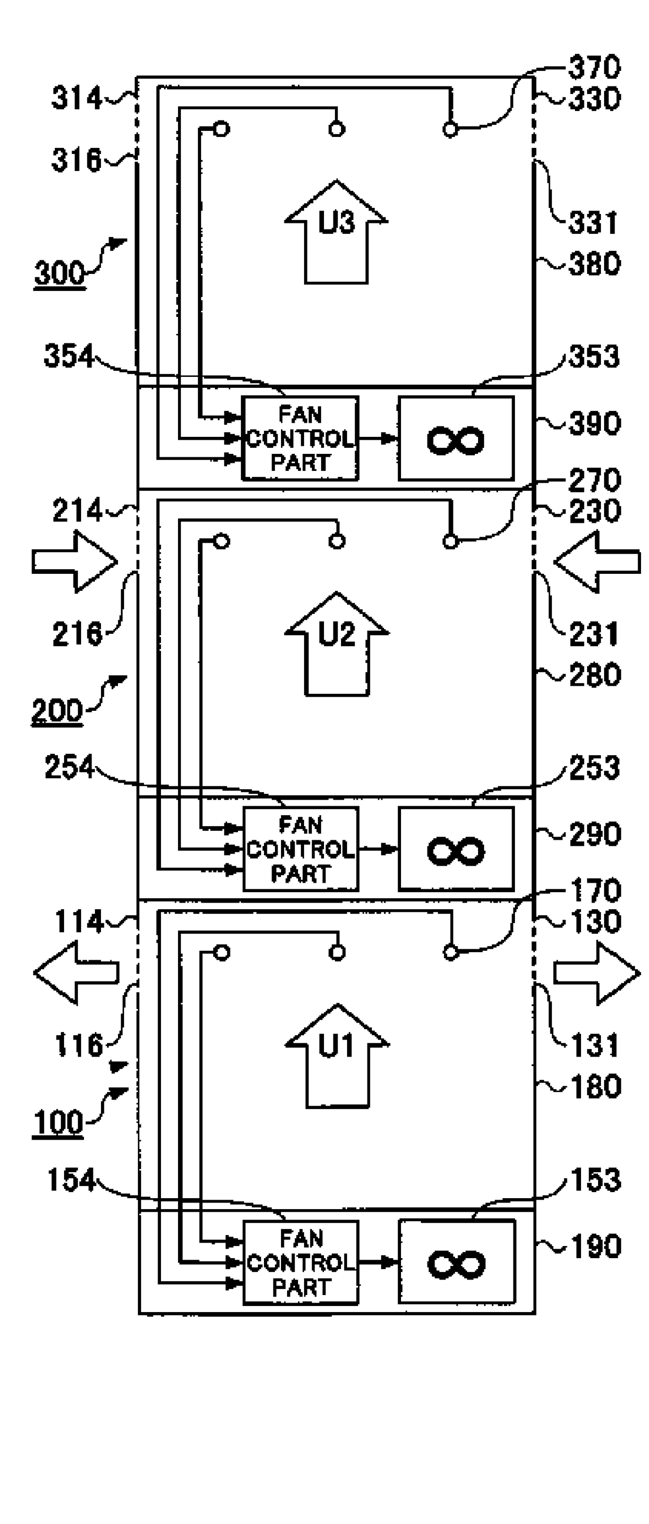


FIG.1

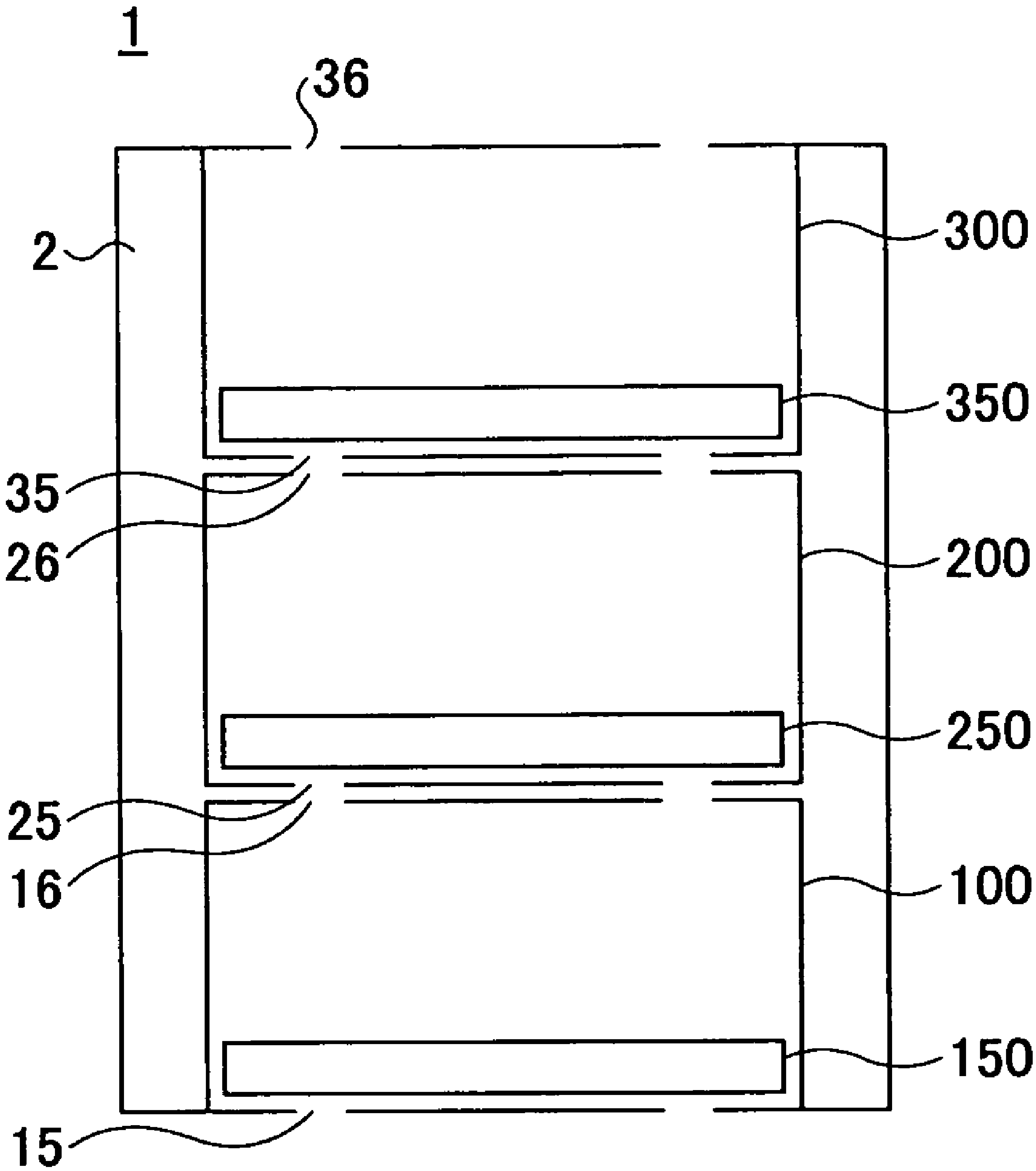


FIG.2

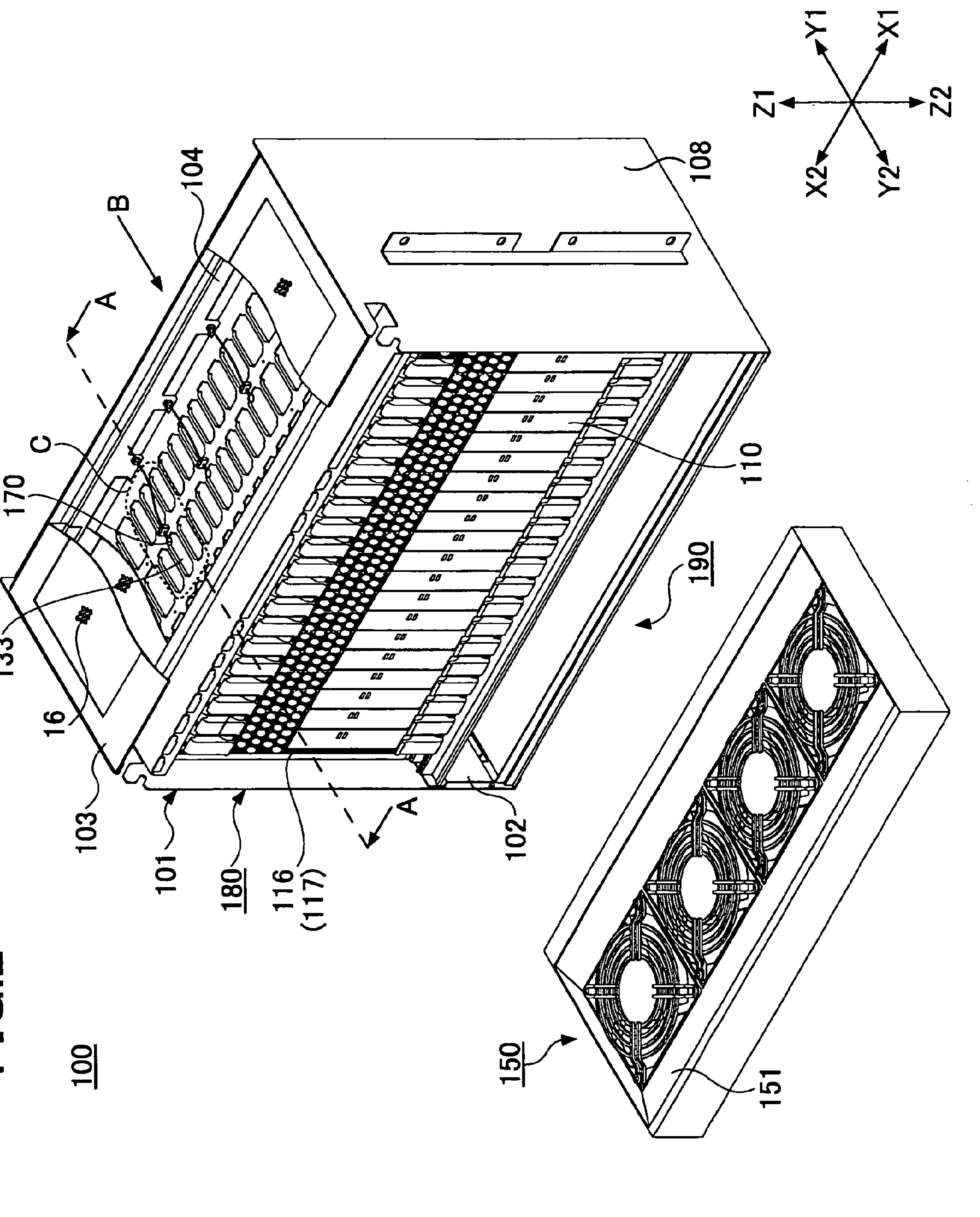

100
104
B
A
C
170
133
16
103
101
180
116
(117)
A
102
110
190
108
150
151
Y1
X1
Z1
Z2
X2
Y2

FIG.3

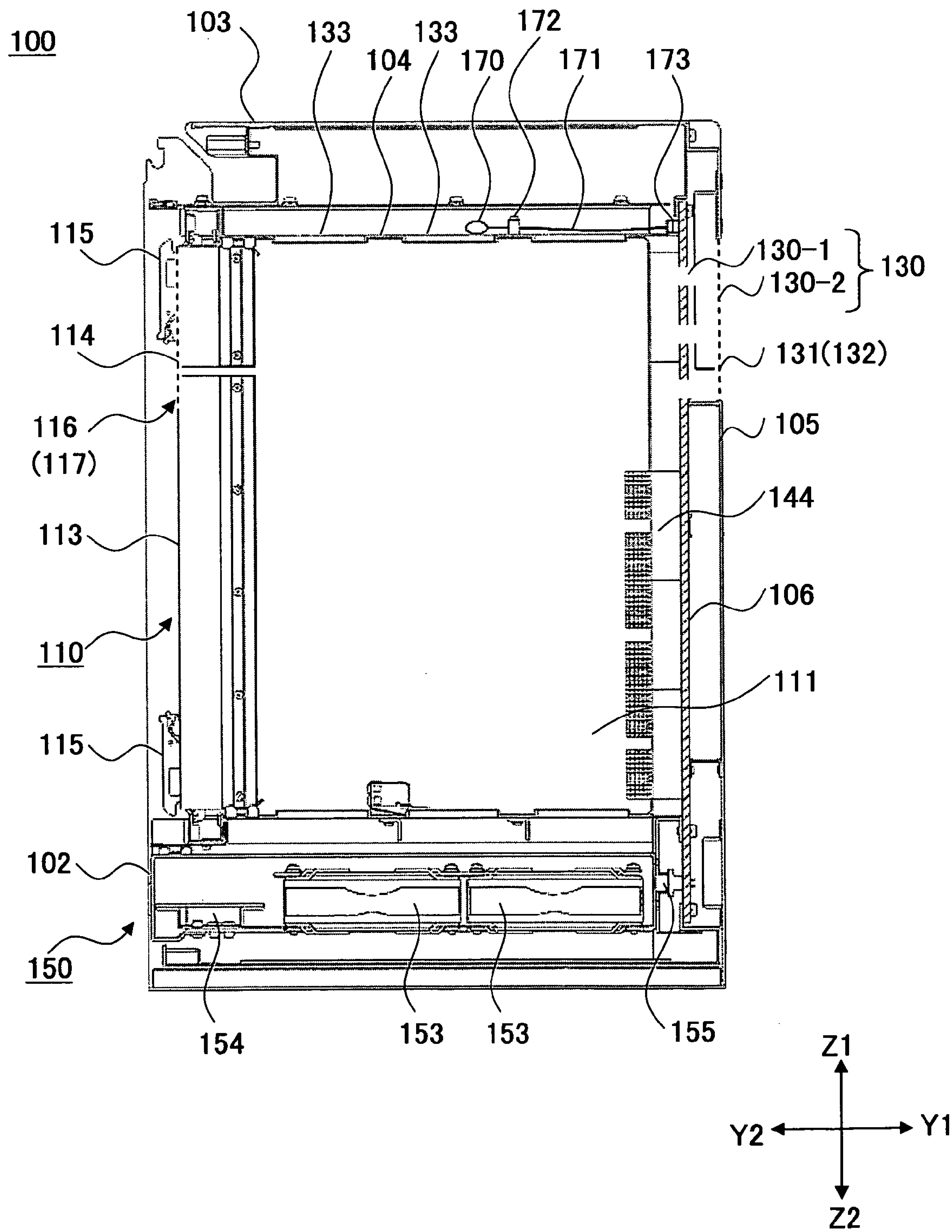

100
103
133
133
104
170
172
171
173
115
130-1
130-2
130
114
131(132)
116
(117)
105
144
113
106
110
111
115
102
150
154
153
153
155
Z1
Y2
Y1
Z2

FIG.4

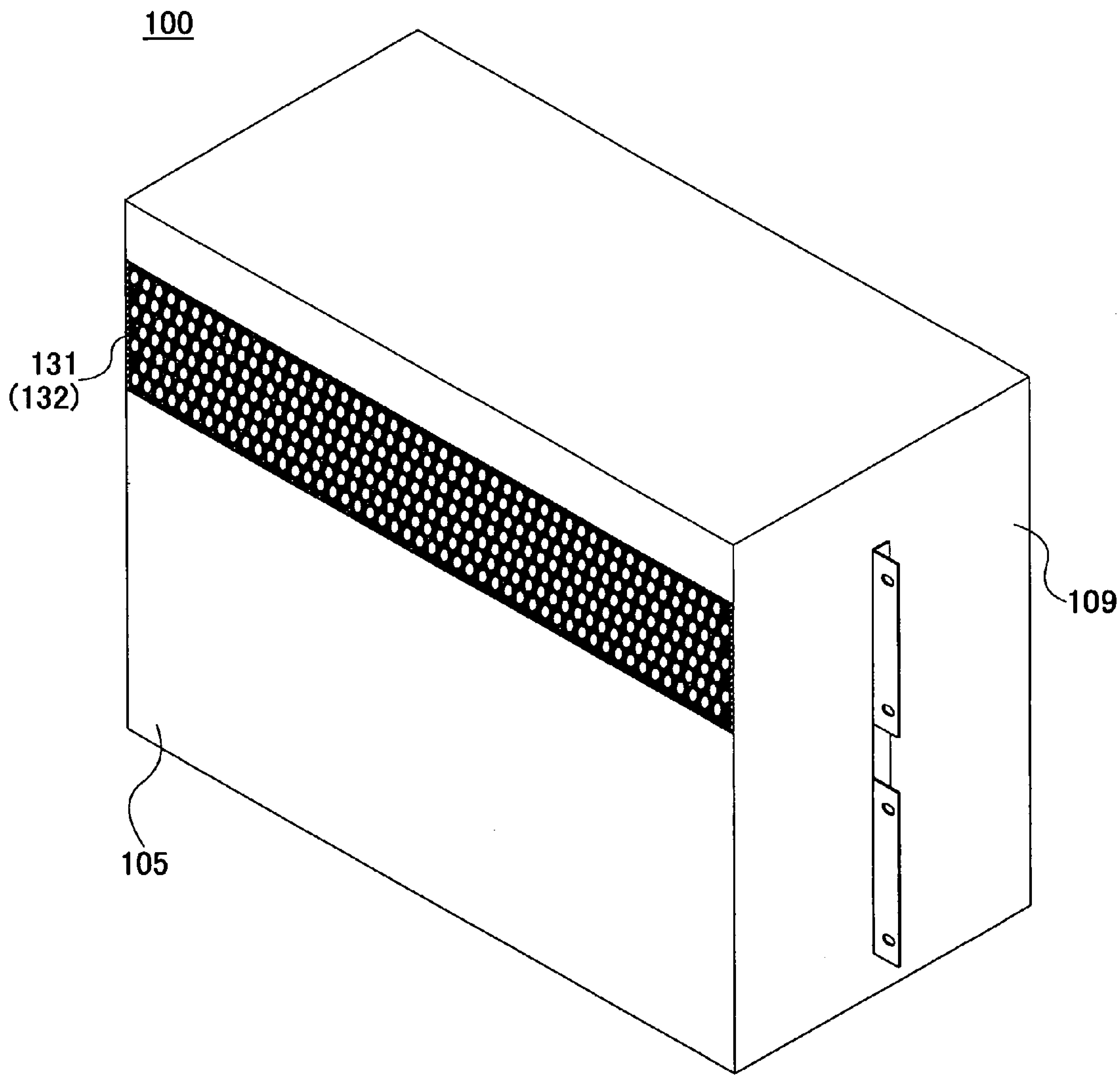


FIG.5

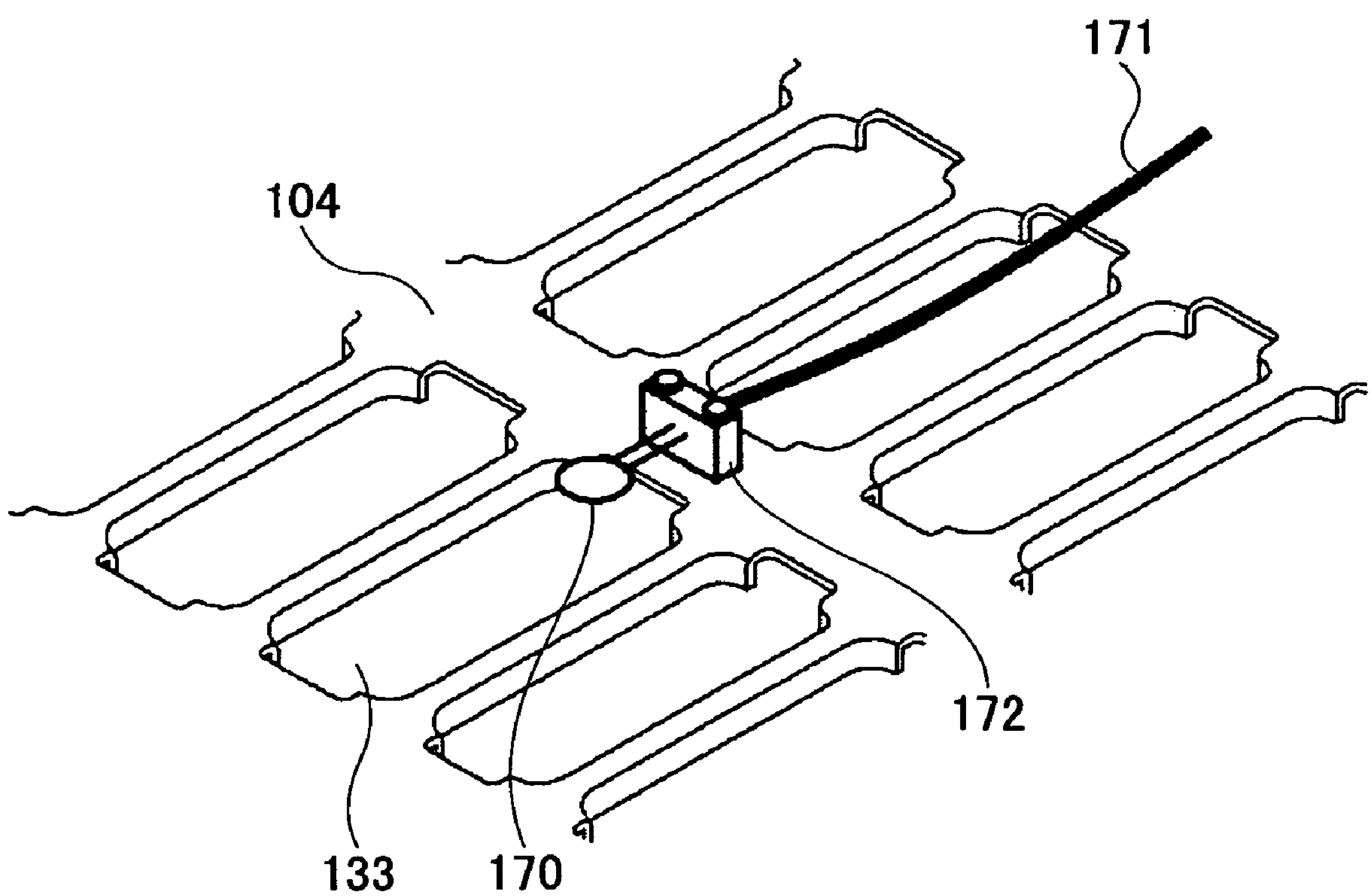


FIG.6

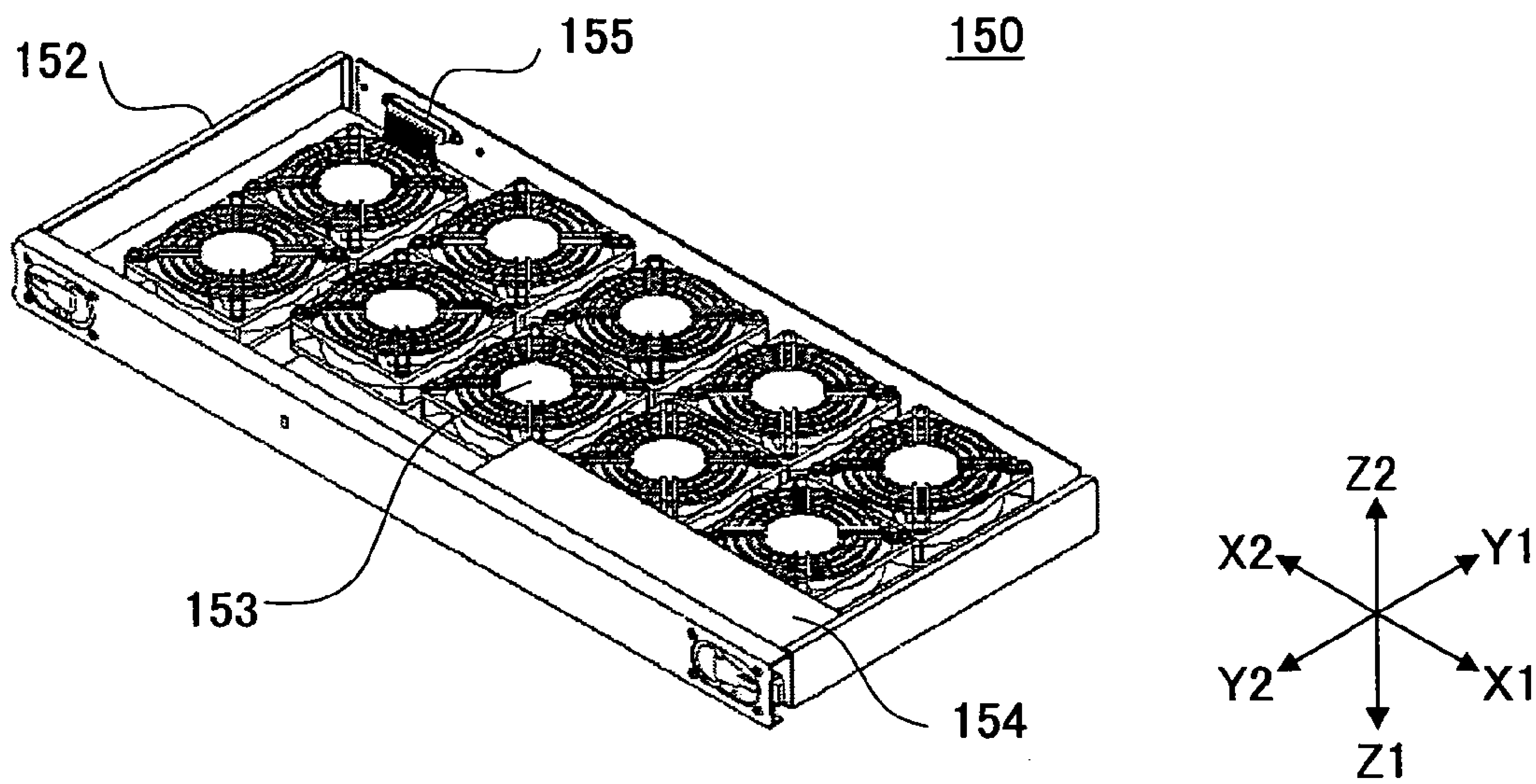

152
155
150
153
154
Z2
X2
Y1
Y2
X1
Z1

FIG.7

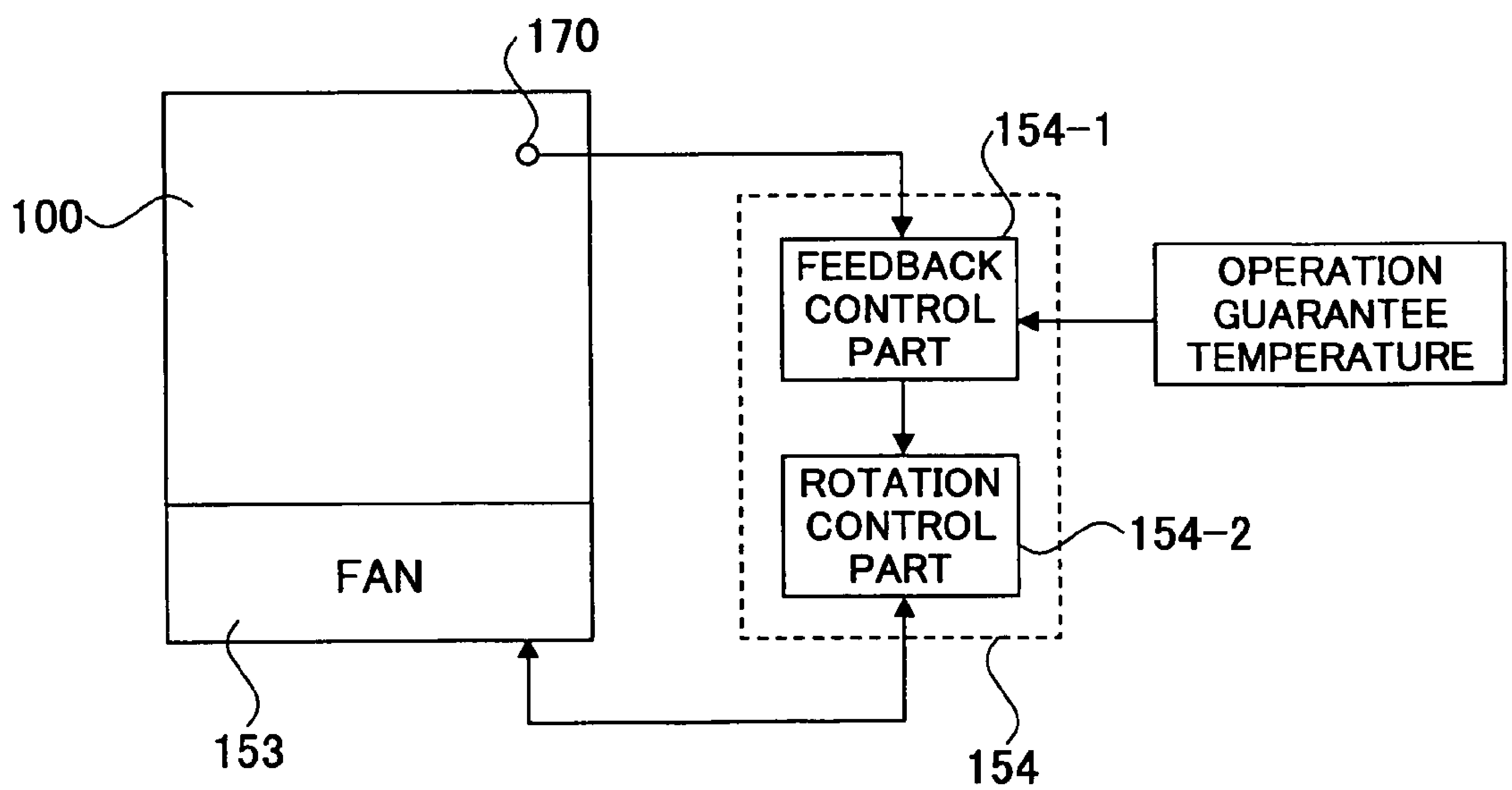

170
154-1
100
FEEDBACK CONTROL PART
OPERATION GUARANTEE TEMPERATURE
ROTATION CONTROL PART
154-2
FAN
153
154

FIG.8

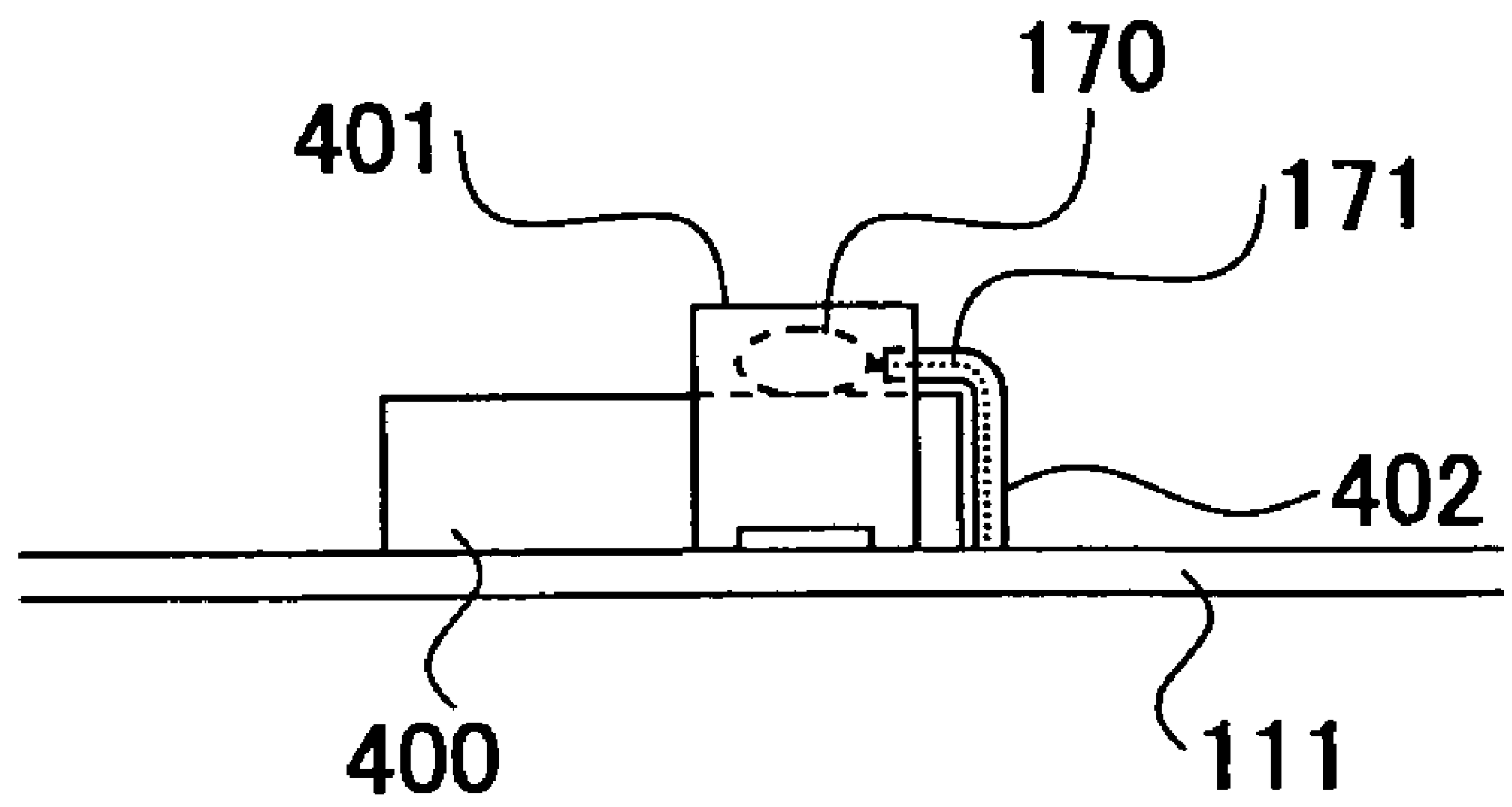


FIG.9

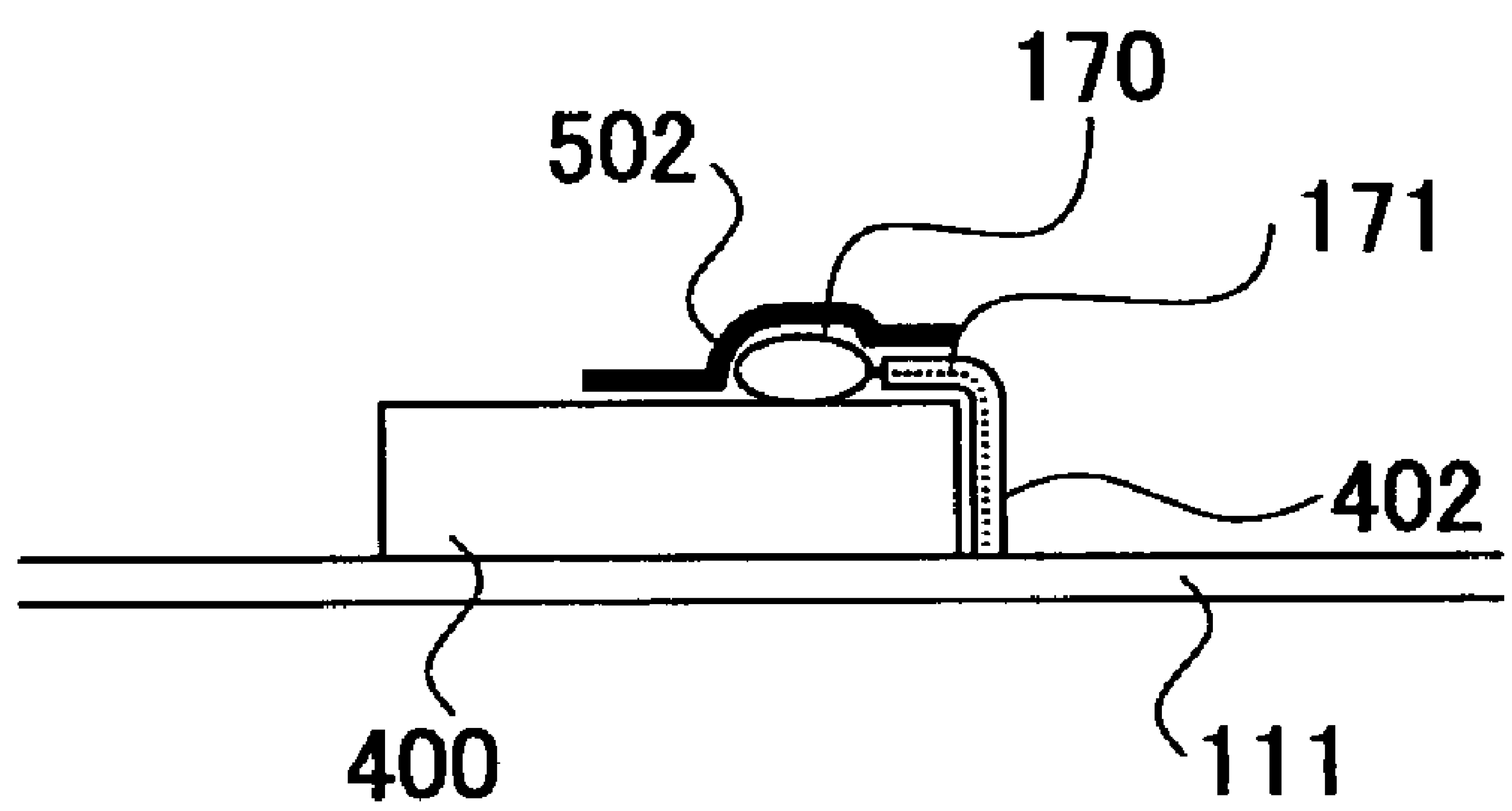


FIG.10

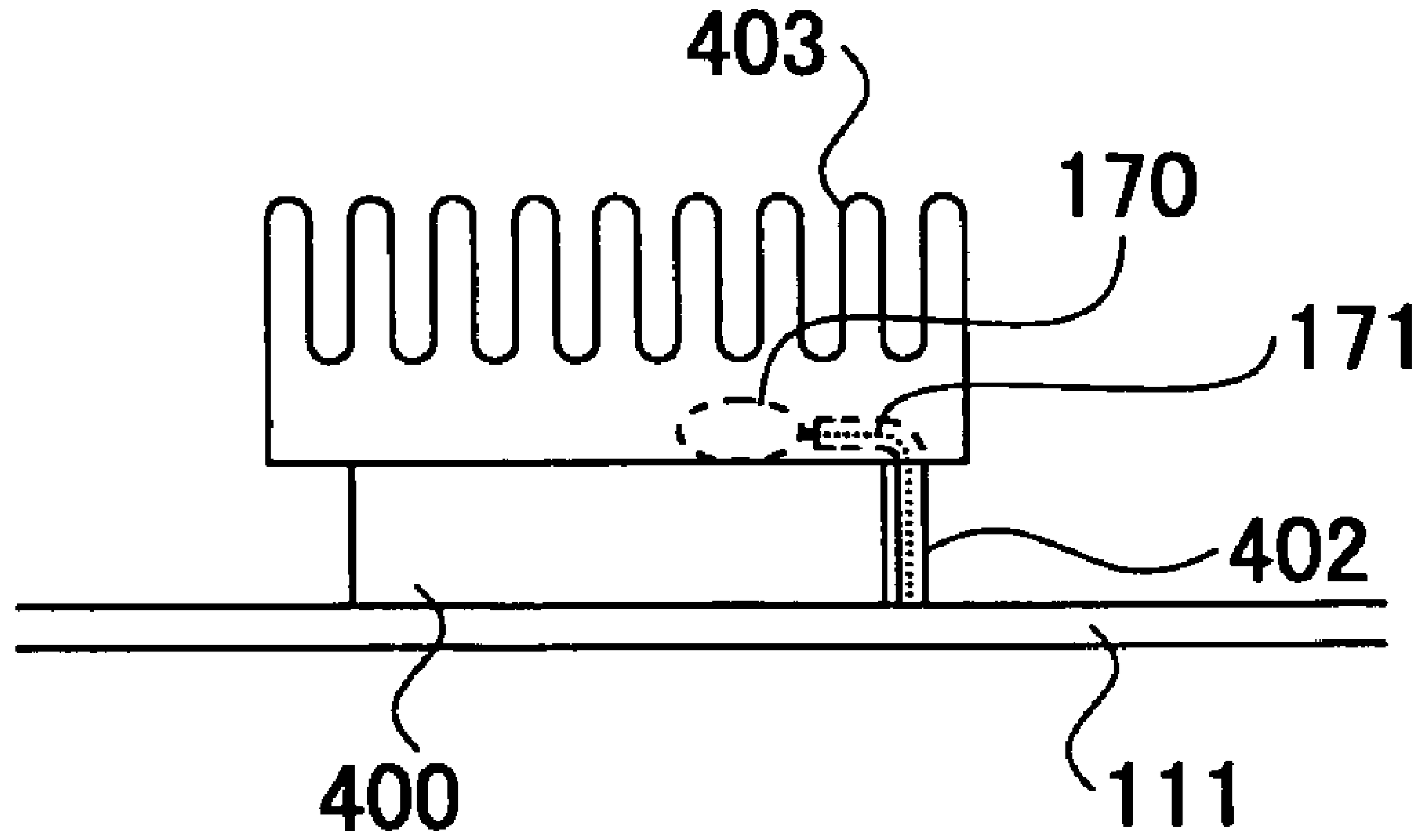
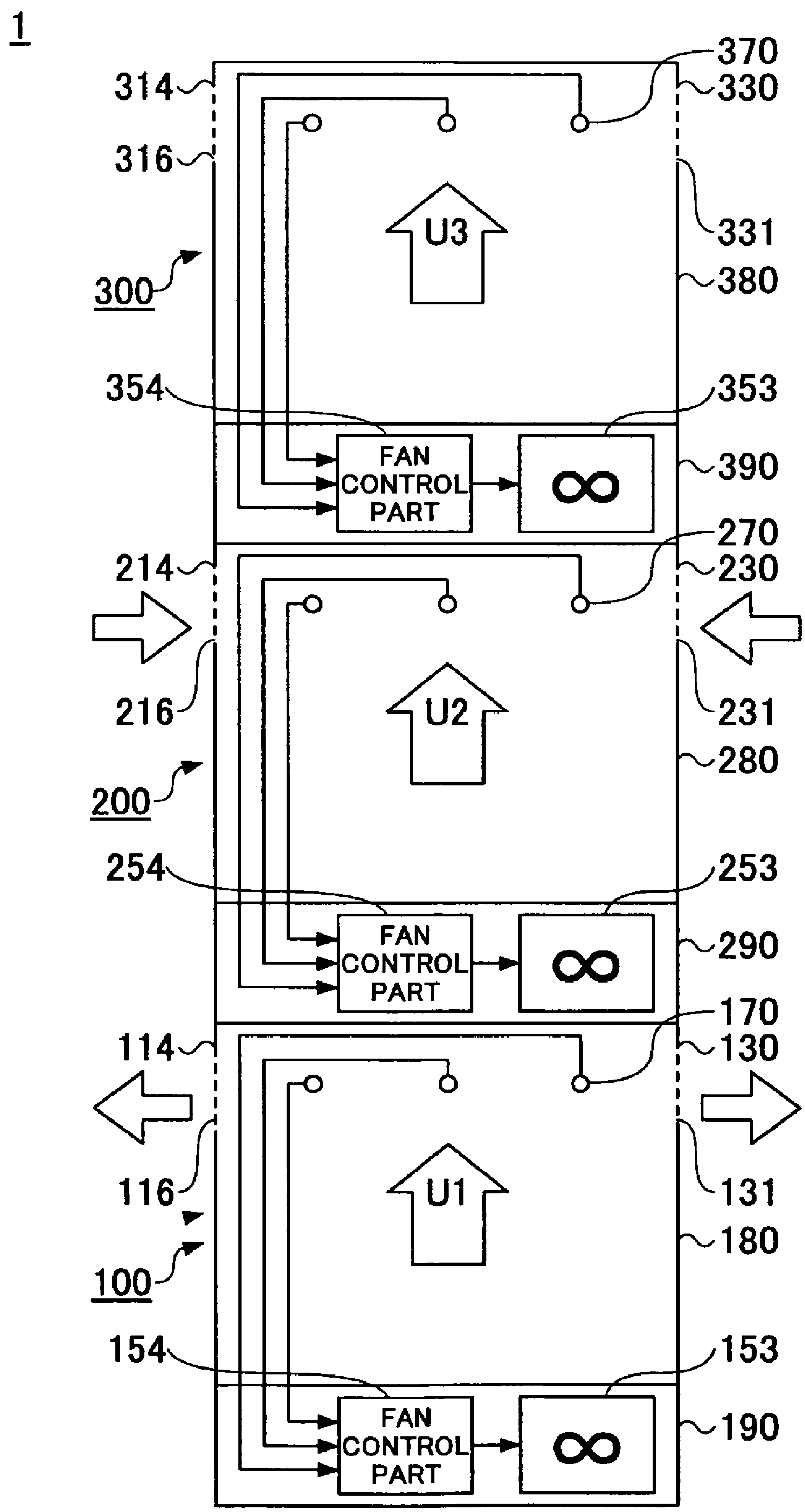


FIG.11


1
314
316
300
354
370
330
331
380
353
U3
FAN CONTROL PART
390
214
216
200
254
270
230
231
280
253
U2
FAN CONTROL PART
290
114
116
100
154
170
130
131
180
153
U1
FAN CONTROL PART
190

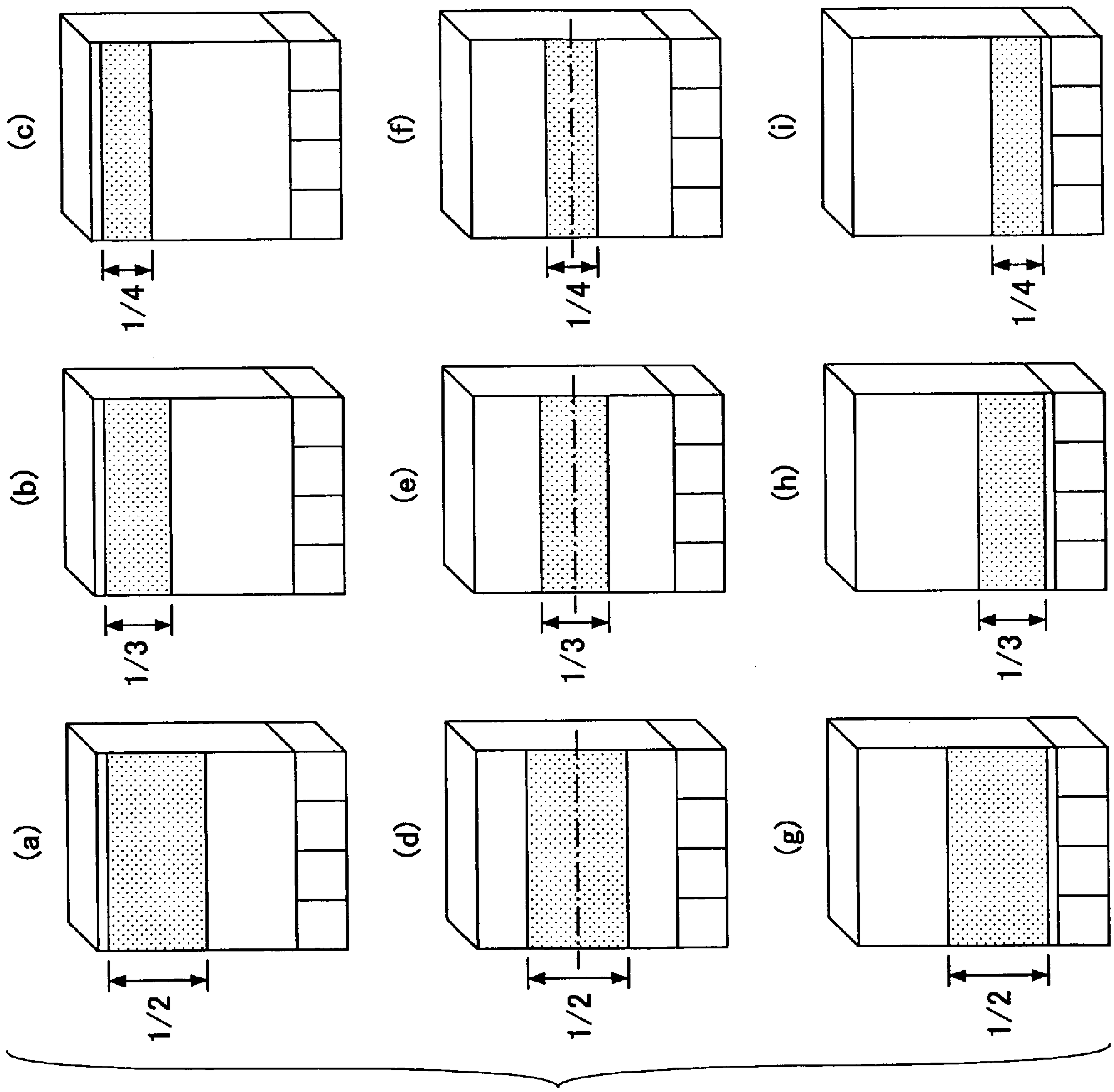


FIG.12

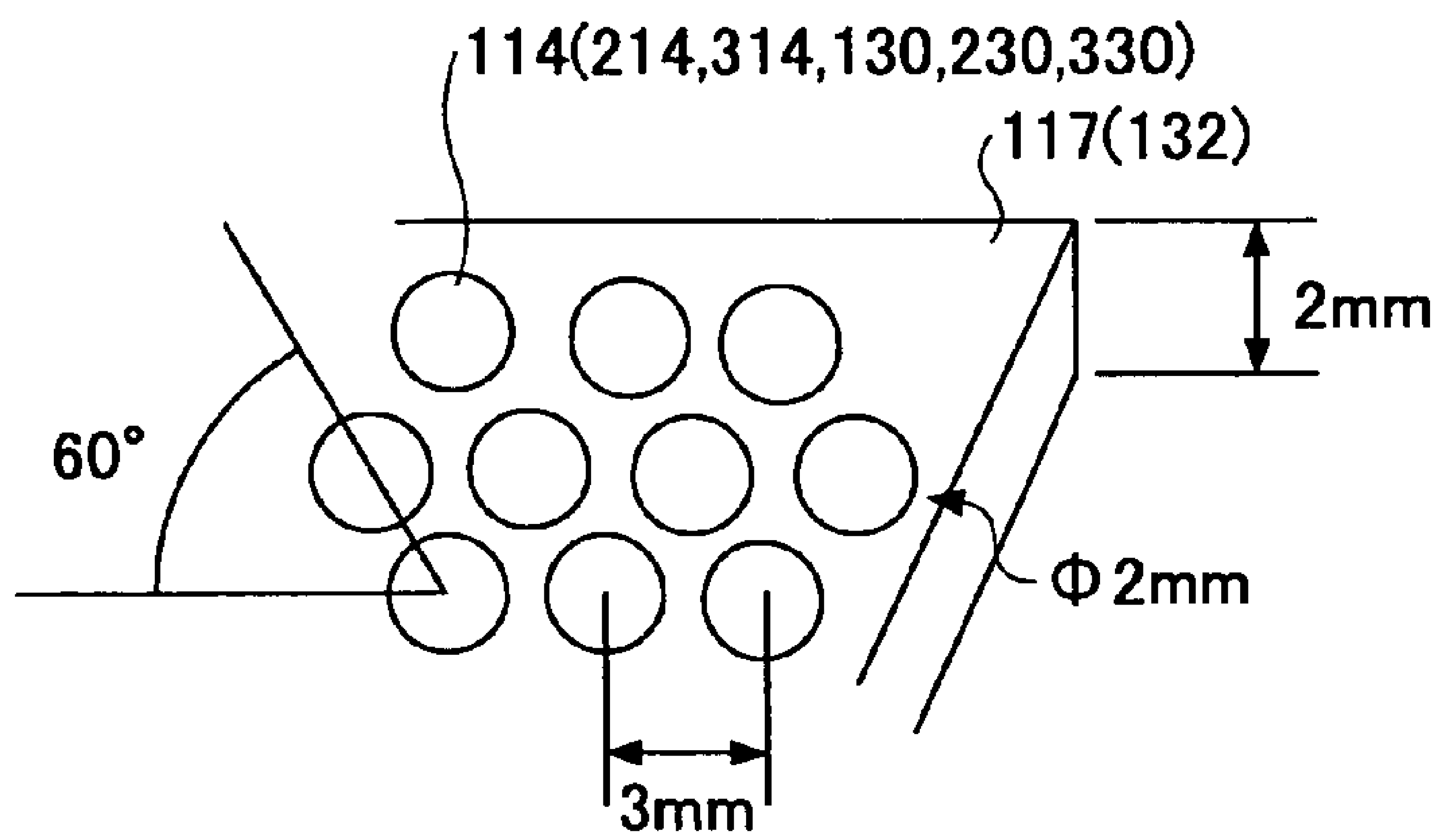
FIG.13

		CASE OF FIG.12 -(a)	CASE OF FIG.12 -(b)	CASE OF FIG.12 -(c)	CASE OF FIG.12 -(d)	CASE OF FIG.12 -(e)	CASE OF FIG.12 -(f)	CASE OF FIG.12 -(g)	CASE OF FIG.12 -(h)	CASE OF FIG.12 -(i)
ELECTRONIC DEVICE MAIN PART 380	UPPER PART	25.9	24.9	24.7	30.8	27.1	26.6	34.3	37.1	38
	CENTER PART	23.3	21.5	22.5	26.7	25.7	29	34.1	34.7	37
	LOWER PART	9.2	9.1	9.1	9.5	9.4	9.4	10	10.2	10.4
ELECTRONIC DEVICE MAIN PART 280	UPPER PART	16.4	13.4	13.1	17.3	16.3	16	16.6	15.8	15.6
	CENTER PART	18.6	17.4	18	18.6	17.7	18.5	18	16.5	16.4
	LOWER PART	8.1	7.9	7.8	8.7	8.6	8.4	10	10.3	10.4
ELECTRONIC DEVICE MAIN PART 180	UPPER PART	13.2	11	11	13.5	12.5	11.9	15.2	15.7	15.9
	CENTER PART	10.6	9.6	10.3	12	11.4	14	14.5	14.1	15.1
	LOWER PART	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

FIG.14

		NUMERICAL APERTURE				
		0%	10%	20%	30%	40%
ELECTRONIC DEVICE MAIN PART 380	UPPER PART	26.4	24.6	24.3	24.7	24.9
	CENTER PART	26.8	22.9	21.9	21.6	21.5
	LOWER PART	11.5	10	9.4	9.2	9.1
ELECTRONIC DEVICE MAIN PART 280	UPPER PART	15.9	14.3	13.6	13.5	13.4
	CENTER PART	16.5	16.2	16.9	17.3	17.4
	LOWER PART	8.7	8	7.9	7.9	7.9
ELECTRONIC DEVICE MAIN PART 180	UPPER PART	13.5	10.9	10.7	10.8	11
	CENTER PART	14.3	10.2	9.8	9.6	9.6
	LOWER PART	0.1	0.1	0.1	0.1	0.1

FIG.15



COOLING STRUCTURE AND COOLING METHOD FOR ELECTRONIC EQUIPMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a U.S. continuation application filed under 35 USC 111(a) and claiming benefit under 35 USC 120 and 365(c) of PCT application No. JP2003/001880 filed on Feb. 20, 2003. The foregoing application is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to cooling structures and cooling methods for electronic equipment, and more particularly, to a cooling structure and a cooling method for electronic equipment which is composed of a plurality of electronic devices superposed on each other.

2. Description of the Related Art

A structure where plural electronic devices are superposed on each other in a rack is applied for electronic equipment such as telecommunication equipment. More specifically, plural plug-in units wherein electronic parts such as an integrated circuit (IC) or a large scale integration circuit (LSI) are mounted on a printed wiring board are received in a shelf. The plug-in unit is plugged in a back board provided in the shelf by a connector of the plug-in unit so that a single electronic device is formed.

In the above-mentioned electronic equipment, the temperature of an inside of the electronic equipment rises due to generation of heat of the electronic parts or others. Because of this, a forced air type of cooling means is applied in order to keep the temperature of the inside of the electronic equipment as a desirable temperature. More specifically, a fan having a high cooling ability is installed and operated into the electronic equipment so that air is forcibly taken in the electronic equipment from the outside and circulated inside of the electronic equipment. As a result of this, the electronic parts which generate heat are cooled and then the heat is discharged outside.

Conventionally, the operation of the fan, which forcibly cools the inside of the electronic equipment wherein plural electronic devices are superposed on each other in the rack, is determined based on an air flow whereby the electronic devices can be cooled so that the temperature in the electronic equipment is prevented from exceeding a temperature at which it is guaranteed that the electronic devices can be properly operated, namely an operation guarantee temperature, on the assumption that the greatest number of the plug-in units are installed in the shelf so that a calorific value generated when the greatest number of the electronic devices are installed in the rack, namely a maximum calorific value, is generated.

According to the above-discussed conventional forced air type cooling means, the fan is set up and always driven so that the air flow corresponding to the maximum calorific value is always generated regardless of the amount of the rack actually occupied by the electronic devices. Therefore, the fan always consumes the maximum amount of consumption electric power.

However, as a matter of fact, the greatest number of the plug-in units is not always installed in the shelf. Hence, there are a lot of cases wherein the calorific power generated by the electronic equipment does not reach to the maximum calorific power.

According to the conventional forced air type cooling means, even in this case, the fan is set up and always driven so that the air flow corresponding to the maximum calorific value is always generated so that the fan generates air flow larger than necessary. Therefore, in the conventional forced air type cooling means, there is waste of electric power.

Meanwhile, in other conventional art, a necessary number of temperature sensors are provided at proper parts in the electric equipment. By this sensor, the temperature of parts generating heat on the printed circuit board is always detected directly or indirectly. In addition, in this art, in order to make the temperature in the electronic equipment be equal to a setting temperature, a signal corresponding to a difference between the temperature in the electronic equipment and the setting temperature is output to a rotation control part.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a novel and useful cooling structure and cooling method for electronic equipment, in which one or more of the problems described above are eliminated.

Another and more specific object of the present invention is to provide a cooling structure and a cooling method for electronic equipment, which is composed of a plurality of electronic devices superposed on each other, whereby the consumption of electric power for driving a fan to forcibly air cool the electronic device can be reduced while the operation guarantee temperature of the electronic device is maintained.

The above object of the present invention is achieved by a cooling structure for electronic equipment including a plurality of electronic devices superposed on each other, each of the electronic devices having a lower part where an air ventilation part configured to ventilate air so as to cool the electronic device is provided, the cooling structure including:

an air intake and exhaust hole forming part which is formed at an upper part of a first one of the electronic devices and below the air ventilation part of a second one of the electronic devices provided on the first electronic device;

wherein air outside of the electronic equipment is taken into an inside of the first electronic device or air inside of the second electronic device is exhausted to the outside of the electronic equipment via the air intake and exhaust hole forming part, so that an amount of the air ventilated inside of the first electric device is controlled.

The electronic device may further include:

a temperature sensing part configured to sense a temperature inside of the electronic device; and

an air ventilation control part configured to control an operation of the air ventilation part, so that the temperature of the inside of the electronic device sensed by the temperature sensing part becomes equal to a designated operation guarantee temperature.

The above object of the present invention is also achieved by a cooling method for electronic equipment including a plurality of electronic devices superposed on each other, the electronic equipment being cooled by ventilating air into the electric device, the cooling method including the step of:

controlling the ventilation of the air in the electric device by taking air outside of the electronic equipment into an inside of the electronic device or exhausting air inside of the electronic device to the outside of the electronic equipment, so that the temperature of the inside of the electronic device sensed by a temperature sensing part becomes equal to a designated operation guarantee temperature.

Other objects, features, and advantages of the present invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic front view showing communication equipment **1**;

FIG. **2** is a view showing a structure of the electronic device **100** shown in FIG. **1**;

FIG. **3** is a cross-sectional view taken of the electronic device **100** shown in FIG. **1** taken along the line A—A in FIG. **2**;

FIG. **4** is a perspective view of the electronic device **100** seen from a direction shown by an arrow B in FIG. **2**;

FIG. **5** is an enlarged view of a part surrounded by a dotted line C of a rail plate **104** shown in FIG. **2**;

FIG. **6** is a perspective view showing an inside structure of a fan unit **150** shown in FIG. **2**;

FIG. **7** is a schematic view showing a method for controlling the number of rotation of a fan **153** by a fan control part **154**;

FIG. **8** is a view showing a first example wherein a sensor **170** is arranged at an electronic part **400** mounted on a printed wiring board **111**;

FIG. **9** is a view showing a second example wherein a sensor **170** is arranged at an electronic part **400** mounted on a printed wiring board **111**;

FIG. **10** is a view showing a third example wherein a sensor **170** is arranged at an electronic part **400** mounted on a printed wiring board **111**;

FIG. **11** is a schematic view of the communication equipment **1** for explaining air flow in the electronic devices **100**, **200** and **300**;

FIG. **12** is a view showing nine conditions with regard to positions and areas of first intake and exhaust hole forming areas **116**, **216** and **316** and second intake and exhaust hole forming areas **131**, **231** and **331** in a first simulation;

FIG. **13** is a table showing results of the first simulation under the conditions shown in FIG. **12**;

FIG. **14** is a table showing results of a second simulation; and

FIG. **15** is a perspective view showing a part of punching metal part **117**.

DETAILED DESCRIPTION OF THE PREFERED EMBODIMENTS

A description is next given, with reference to FIG. **1** through FIG. **15**, of embodiments of the present invention. In the following embodiment, communication equipment is explained as an example of electronic equipment.

FIG. **1** is a schematic front view showing communication equipment **1**.

Referring to FIG. **1**, communication equipment **1** of the present invention has a rack **2** where plural shelves are provided in a vertical direction of the communication equipment **1**. Electronic devices **100**, **200**, and **300** are respectively provided on the shelves. Hence, the electronic devices **100**, **200**, and **300** are superposed on each other in the vertical direction in order from a bottom part of the communication equipment **1**. Fan units **150**, **250**, and **350** configured to cool insides of the electronic devices **100**, **200**, and **300** are respectively inserted and installed in lower parts of the electronic devices **100**, **200**, and **300**. Air intake hole forming parts **15**, **25**, and **35** are formed on bottom surfaces of the electronic devices **100**, **200**, and **300**. Air exhaust hole forming parts **16**, **26**, and **36** are formed on upper surfaces of the electronic devices **100**, **200**, and **300**.

Based on drive of the fan units **150**, **250**, and **300**, air is ventilated (circulated) inside of the electronic devices **100**, **200**, and **300** so that the inside of the electronic devices **100**, **200**, and **300** is cooled.

FIG. **2** is a view showing a structure of the electronic device **100** shown in FIG. **1**. More specifically, FIG. **2** is a perspective view of the electronic device **100** in a state before the fan unit **150** is inserted and installed into the electronic device **100**. In FIG. **2**, an illustration of a part of ceiling plate **103** provided on the upper surface (end surface in the Z1 direction) of the electronic device **100** is omitted to easily understand an inside structure of the electronic device **100**.

FIG. **3** is a cross-sectional view of the electronic device **100** shown in FIG. **1** taken along the line A—A in FIG. **2**. FIG. **4** is a perspective view of the electronic device **100** seen from a direction shown by an arrow B in FIG. **2**.

Structures of the electronic devices **200** and **300** are same as the structure of the electronic device **100**. Hence, explanation of the electronic device **100** represents explanations of the electronic devices **200** and **300**.

Referring to FIG. **2**, the electronic device **100** has a shelf **101** having a substantially box configuration. In the shelf **101**, several plug-in units **110** which are objects to be cooled are installed in a horizontal width direction, namely X1–X2 direction, in parallel so as to form an electronic device main body part **180**.

The plug-in unit **110** is inserted inside of the shelf **101** by sliding on a rail member (not shown) provided inside of the electronic device **100** and on a rail plate **104** whose upper surface is covered with the ceiling plate **103** provided on the upper surface (end surface in the Z1 direction) of the electronic device **100**.

A fan unit installation part **102** is formed inside of the electronic device **100** and below the electronic device main body part **180**. The fan unit **150** is installed in the fan unit installation part **102** so as to cool the inside of the electronic device **100**. By inserting the fan unit **150** into the fan unit installation part **102**, the fan unit **150** is installed inside of the electronic device **100** so that a fan installation part **190** is formed.

Referring to FIG. **3**, a back surface cover member **105** is provided on a back surface of the electronic device **100**, namely an end surface of the electronic device **100** in the Y1 direction. A back wiring board (hereinafter "BWB") **106** is provided in a height direction, namely Z1–Z2 direction of the electronic device **100**, at a position slightly separated from the back surface cover member **105** in the Y2 direction.

The plug-in unit **110** has a printed wiring board **111** where electronic parts not shown in FIG. **3** are mounted. A surface plate **113** is provided at an end part in the Y2 direction of the printed wiring board **111**. A lever **115** is rotatably provided at each of end parts of a upper side, namely in the Z1 direction and a lower side in the Z2 direction, of the surface plate **113**.

A plug-in unit connector part **144** is provided at an end part in the Y1 direction of the printed wiring board **111**. When the plug-in unit **110** is slid so that the plug-in unit **110** is completely inserted inside of the electronic device **100**, the plug-in unit connector part **144** is engaged with a connector (not shown in FIG. **3**) of the BWB **106** of the electronic device **100** so that a plug-in connection is made and thereby a connection for an electric signal is provided.

Furthermore, the plug-in unit **110** is fixed to the electronic device **100** by rotating the levers **115** provided the end parts of the upper side, namely in the Z**1** direction and the lower side in the Z**2** direction, of the surface plate **113**.

A first air intake and exhaust hole forming area **116** is formed in a part that is the upper one third of the whole area of the surface plate **113**. A punching metal part **117** where a designated number of first intake and exhaust hole forming parts **114** having designated diameters and areas are formed is installed in the first air intake and exhaust hole forming area **116**. By the first intake and exhaust hole forming parts **114**, air outside of the electronic device **100** is taken into an inside of the electronic device **100** or air inside of the electronic device **100** is exhausted to the outside of the electronic device **100**.

A back board air intake and exhaust hole forming part **130-1** is formed in an area corresponding to the first air intake and exhaust hole forming area **116** at an upper part of the BWB **106**. Furthermore, a second air intake and exhaust hole forming area **131** is formed in an area corresponding to the first air intake and exhaust hole forming area **116** at the back surface cover member **105**. More specifically, a punching metal part **132** where a designated number of back surface cover air intake and exhaust hole forming parts **130-2** are formed is installed in the second air intake and exhaust hole forming area **131**. See FIG. **4**, too.

The back board air intake and exhaust hole forming part **130-1** and the back surface cover air intake and exhaust hole forming part **130-2** form a second air intake and exhaust hole forming part **130**. By the second intake and exhaust hole forming parts **130**, air outside of the electronic device **100** is taken into an inside of the electronic device **100** or air inside of the electronic device **100** is exhausted to the outside of the electronic device **100**.

While the electronic device **100** is partially opened to the outside by the above-mentioned first air intake and exhaust hole forming part **114** and second air intake and exhaust hole forming part **130**, the leakage of electromagnetic waves to the outside of the electronic device **100** is prevented due to shielding by the above-mentioned punching metal part **117** and the punching metal part **132**. That is, the punching metal part **117** and the punching metal part **132** function as electromagnetic wave shielding members.

As described above, the punching metal part **132** installed at the back surface cover **105** situated more outside than the BWB **106** works as means for shielding the electromagnetic wave from leaking to the outside of the electronic device **100** at a side of a back surface of the electronic device **100**, namely at the side of the Y**1** direction. Hence, it is not necessary to provide such means at the BEB **106**.

Thus, in this embodiment, the first intake and exhaust hole forming part **114** is installed at the front surface side of the electronic device **100**, namely Y**2** side in FIG. **2**, and the second intake and exhaust hole forming parts **130** is installed at the back surface side of the electronic device **100**, namely Y**1** side in FIG. **2**. However, the present invention is not limited to the above-mentioned structure. For example, the first intake and exhaust hole forming part **114** may be installed in a side surface **108** (See FIG. **2**) situated at the X**1** side in FIG. **2** of the electronic device **100**, and the second intake and exhaust hole forming part **130** may be installed in a side surface **109** (See FIG. **4**) situated at the X**2** side in FIG. **2** of the electronic device **100**.

The above mentioned first air intake and exhaust hole forming area **116** and second air intake and exhaust hole forming area **131** work as air intake and exhaust hole forming areas. The first intake and exhaust hole forming part **114** and second intake and exhaust hole forming part **130** work as air intake and exhaust hole forming parts.

Next, the structure of a rail plate **104** is discussed.

FIG. **5** is an enlarged view of a part surrounded by a dotted line C of a rail plate **104** shown in FIG. **2**.

Referring to FIG. **3** and FIG. **5**, a large number of rail plate hole forming parts **133** are arranged in the rail plate **104**. By driving a fan unit **150** described later, air in the electronic device **100** is blown to an electronic device **200** (See FIG. **1**) provided above the electronic device **100** via the rail plate hole forming parts **133**, the air exhaust hole forming part **16** (See FIG. **1**), and the air intake hole forming part **25** (See FIG. **1**) of the electronic device **200**.

A designated number of sockets **172** for installing sensors, described later, are screw-fixed at designated parts of the rail plate **104** where the above-mentioned rail plate hole forming parts **133** are not formed.

A sensor is connected to the socket **172**. The sensor **170** faces the rail plate hole forming part **133** which is a part where the air inside of the electronic device **100** passes.

The sensor **170** is a thermistor, for example, and works as a temperature sensor. In this embodiment, the sensor **170** measures air temperature inside of the electronic device **100**. An optional number of the sensors **170** are provided at measuring parts which are determined in advance by a temperature simulation or the like.

A cable **171** for sensing is also connected to the socket **172**. A connector **173** (See FIG. **3**) is provided at an end part at a side not connected to the socket **172** of the cable **171**. The connector **173** is connected to the BWB **106** (See FIG. **3**). Under this structure, the sensor is electrically connected to the BWB **106**.

Next, the structure of a fan unit **150** is discussed.

FIG. **6** is a perspective view showing an inside structure of the fan unit **150** shown in FIG. **2**. In FIG. **6**, a cover member **151** (See FIG. **2**) covering a part of an upper side of the fan unit **150** is removed.

Referring to FIG. **6**, the fan unit **150** has a frame body **152** whose plane rectangular-shaped configuration is substantially the same as the plane configuration of the shelf **101** (See FIG. **2**).

Plural fans **153**, ten fans **153** as shown in FIG. **6** for example, are arranged in a level plane in the frame body **152**. For example, a direct current (DC) drive axial fan or the like can be used as the fan **153**. The fan **153** works as an air ventilation part. By driving the fan **153**, air inside of the electronic device **100** is blown up from a lower part to an upper part, namely in the Z**1** direction in FIG. **2**, so that the inside of the electronic device **100** is cooled.

A fan control part **154** is provided at an inside of the frame body **152** and a front surface side, namely the Y**2** direction side. The fan control part **154** has a printed circuit board (not shown in FIG. **6**) for a fan control circuit for controlling the number of rotations of the fans **153**.

A fan unit connector **155** is provided at the back surface side, namely the Y**1** direction side, of the frame body **152** so as to be connected to the BWB **106** (See FIG. **3**). The fans **153**, the fan control part **154** and the fan unit connector **155** are connected to each other by a cable (not shown in FIG. **6**). Therefore, the fans **153** and the fan control part **154** are electrically connected to the BWN **106** (See FIG. **3**) via the fan unit connector **155**.

Meanwhile, as discussed with reference to FIG. **3**, the sensor **170** provided at the upper part of the electronic device **100** is electrically connected to the BWB **106** via the cable **171**.

Therefore, the temperature of the inside of the electronic device **100** sensed by the sensor **170** is transmitted to the BWB **106** via the cable **171** as a voltage change and then transmitted to the fan unit connector **155** provided in the fan unit **150** via a circuit pattern formed in the BWB **106**. Based on the transmitted information, the fan control part **154** of the fan unit **150** controls the number of rotations of the fans **153** and works as an air ventilation part controlling part.

FIG. **7** is a schematic view showing a method for controlling the number of rotations of the fans **153** by the fan control part **154**. For convenience of explanation, the fan control part **154** is shown taken out from the electronic device **100** in FIG. **7**.

Referring to FIG. **7**, the fan control part **154** includes a feedback control part **154-1** and a rotation control part **154-2**.

As described above, temperature of the inside of the electronic device **100**, sensed by the sensor **170**, is transmitted to the fan control part **154**. The feedback control part **154-1** of the fan control part **154** compares the temperature of the inside of the electronic device **100**, sensed by the sensor **170**, and an operation guarantee temperature which is set in advance as a temperature at which it is guaranteed that the electronic device **100** properly operates.

The feedback control part **154-1** further outputs a control signal in proportion to a temperature difference of the above-mentioned temperatures to the rotation control part **154-2**, so that the temperature of the inside of the electronic device **100** becomes equal to the operation guarantee temperature.

The rotation control part **154-2** controls the number of rotations of the fans **153** based on an output signal of the feedback control part **154-1** so that the temperature of the inside of the electronic device **100** is maintained constant at the operation guarantee temperature. More specifically, when the temperature of the inside of the electronic device **100** is higher than the operation guarantee temperature, the rotation control part **154-2** increases the number of the rotations of the fans **153** so that the number of the rotations of the fans **153** becomes high. When the temperature of the inside of the electronic device **100** is lower than the operation guarantee temperature, the rotation control part **154-2** decreases the number of the rotations of the fans **153** so that the number of the rotations of the fans **153** becomes low.

Meanwhile, as discussed with reference to FIG. **2**, FIG. **3**, and FIG. **5**, in this embodiment, the sensor **170** provided at the upper parts of the electronic devices **100**, **200**, and **300** senses a temperature of inside air atmosphere of the electronic devices **100**, **200**, and **300**.

However, the present invention is not limited to the above-mentioned structure. For example, as shown in FIG. **8**, FIG. **9**, and FIG. **10**, the sensor **170** may be attached to an electronic parts mounted on the printed wiring board **111** of the plug-in unit **110** shown in FIG. **2** and FIG. **3**.

FIG. **8** is a view showing a first example wherein the sensor **170** is arranged at an electronic part **400** mounted on the printed wiring board **111**.

Referring to FIG. **8**, the sensor **170** is mounted on the electronic part **400**. The sensor **170** and the electronic part **400** are covered with a pushing metal fitting member **401** so that the sensor **170** is pushed and fixed on the electronic part **400**.

Furthermore, the cable **170** for the sensor **170** which is connected to the sensor **171** is covered with a tube member **402**. An end, where the sensor **170** is not connected, of the cable **171** covered with the tube member **402** is taken in the wiring pattern (not shown) of the printed wiring board **111**.

FIG. **9** is a view showing a second example wherein the sensor **170** is arranged at the electronic part **400** mounted on the printed wiring board **111**.

Referring to FIG. **9**, the sensor **170** is mounted on the electronic part **400** and fixed on the electronic part **400** by a tape **502**. The tape **502** has a high insulating property against temperature change.

As well as the case shown in FIG. **8**, the cable **171** for the sensor **170** which is connected to the sensor **170** is covered with the tube member **402**. An end, where the sensor **170** is not connected, of the cable **171** covered with the tube member **402** is taken in the wiring pattern (not shown) of the printed wiring board **111**.

FIG. **10** is a view showing a third example wherein the sensor **170** is arranged at the electronic part **400** mounted on the printed wiring board **111**.

Referring to FIG. **10**, the sensor is mounted on the electronic part **400**. A fin **403** is provided on the electronic part **400** and the sensor **170** so that the sensor **170** is put between the electronic part **400** and the fin **403**.

Furthermore, as well as the cases shown in FIG. **8** and FIG. **9**, the cable **171** connected to the sensor **179** is covered with the tube member **402**. An end, where the sensor **170** is not connected, of the cable **171** covered with the tube member **402** is taken in the wiring pattern (not shown) of the printed wiring board **111**.

Under structures shown in FIG. **8** through FIG. **10**, by plugging in the plug-in unit **110** shown in FIG. **3** to the BWB **106**, the temperature of the electronic part **400** sensed by the sensor **170** is transmitted to the BWB **106** as a voltage change, and then transmitted to the fan unit connector **155** provided in the fan unit **150** via the circuit pattern formed in the BWB **106**. Based on the transmitted information, the fan control part **154** of the fan unit **150** controls the number of rotations of the fans **153**. See FIG. **3**.

According to the structures shown in FIG. **8** through FIG. **10**, even if an allowable temperature of the electronic part **400** mounted on the printed wiring board **111** of the plug-in unit **110** is low, it is possible to securely sense the temperature of the electronic part **400** and control the number of the rotations of the fans **153** so that the temperature of the electronic part **400** is prevented from being higher than the operation guarantee temperature. Because of this, it is possible to protect the electronic part **400** mounted on the printed wiring board **111** of the plug-in unit **110**.

The sensor **170** may be provided at a part corresponding to a measurement point set in advance in the plug-in unit **110** based on a result of a temperature simulation, for example.

Next, a method for cooling the communication equipment **1** of the present invention having the electronic devices **100**, **200**, and **300** having the above-mentioned structures is discussed.

FIG. **11** is a schematic view of the communication equipment **1** for explaining an air flow in the electronic devices **100**, **200** and **300**.

As described above, the electronic device **100** includes an electronic device main part **180** and a fan installation part **190** provided below the electronic device main part **180**. The sensor **170** for sensing a temperature inside of the electronic device **100** is provided inside of the electronic device main part **180**. The fan control part **154** of the fan installation part **190** controls the number of rotations of the fans **153** so that the temperature inside of the electronic device **100** which is sensed by the sensor **170** becomes a constant operation guarantee temperature.

Furthermore, at the upper part of the electronic device main part **180**, the first intake and exhaust hole forming part **114** and second intake and exhaust hole forming part **130** are provided in the first air intake and exhaust hole forming area **116** and second air intake and exhaust hole forming area **131** so that the air outside of the electronic device **100** can be taken inside of the electronic device **100** or air inside of the electronic device **100** can be exhausted outside of the electronic device **100**.

Furthermore, as described above, the electronic device **200** also has the same structure as the electronic device **100**. That is, as shown in FIG. **11**, the electronic device **200** includes an electronic device main part **280**, a fan installation part **290**, a fan control part **254**, a fan **253**, a sensor **270**, a first air intake and exhaust hole forming part **214**, a second air intake and exhaust hole forming part **230**, a first air intake and exhaust hole forming area **216**, and a second air intake and exhaust hole forming area **231**.

Similarly, the electronic device **300** also has the same structure as the electronic device **100**. That is, as shown in FIG. **11**, the electronic device **300** includes an electronic device main part **380**, a fan installation part **390**, a fan control part **354**, a fan **353**, a sensor **370**, a first air intake and exhaust hole forming part **314**, a second air intake and exhaust hole forming part **330**, a first air intake and exhaust hole forming area **316**, and a second air intake and exhaust hole forming area **331**.

That is, in this embodiment, the electronic devices **100**, **200** and **300** are superposed on each other in the height direction of the communication equipment **1**. The fan installation part **290** provided at the lower part of the electronic device **200** provided on the electronic device **100** and the first air intake and exhaust forming part **114** and the second air intake and exhaust forming part **130** provided at the upper part of the electronic device **100** are adjacently positioned.

Similarly, the fan installation part **390** provided at the lower part of the electronic device **300** provided on the electronic device **200** and the first air intake and exhaust forming part **214** and the second air intake and exhaust forming part **230** provided at the upper part of the electronic device **200** are adjacently positioned.

Under this structure, the communication equipment **1** of the present invention is cooled according to the following equation 1 showing an air flow of air which flows inside of the electronic devices **100**, **200** and **300**.

$$V1=V2+V3 \qquad \text{[Equation 1]}$$

Here, V**1** represents the air flow of air propelled from a fan from an electronic device (**1**). V**2** represents an air flow set from another electronic device (**2**) provided below the electronic device (**1**) to a fan of the electronic device (**1**). V**3** represents an air flow which is taken in or exhausted from the first and second air intake and exhaust hole forming parts of the electronic device (**2**) provided below the electronic device (**1**). A case of "intake" is expressed as a positive, and a case of "exhaust" is expressed as a negative.

For example, it is hypothetically assumed that the temperature inside of the electronic device **100** and the temperature inside of the electronic device **300** are higher than the operation guarantee temperature, and the temperature inside of the electronic device **200** is lower than the operation guarantee temperature.

In this case, in the electronic device **100** whose inside has a temperature higher than the operation guarantee temperature, the fan control part **154** makes the fan **153** rotate at a high speed based on a sensing result of the sensor **170** in order to make the inside temperature of the electronic device **100** become equal to the operation guarantee temperature.

On the other hand, in the electronic device **200** whose inside has a temperature lower than the operation guarantee temperature, the fan control part **254** makes the fan **253** rotate at a low speed based on a sensing result of the sensor **270**.

Therefore, an air flow U**1** generated inside of the electronic device **100** by the rotation of the fan **153** and sent to the electronic device **200** is larger than an air flow U**2** generated inside of the electronic device **200** by the rotation of the fan **253**.

The first air intake and exhaust hole forming part **114** and the second air intake and exhaust hole forming part **130** are provided in the vicinity of a lower side of the fan installation part **290** of the electronic device **200** provided on the electronic device **100**. Hence, air having a high temperature inside of the electronic device **100** is exhausted from the first air intake and exhaust hole forming part **114** and the second air intake and exhaust hole forming part **130** and the above-mentioned equation 1 is satisfied.

Thus, it is possible to control air flowing in the electronic device **200** so that waste of electric power due to rotation of the fan **253** in vain can be prevented.

In the electronic device **200** whose inside has a temperature lower than the operation guarantee temperature, the fan control part **254** makes the fan **253** rotate at a low speed based on a sensing result of the sensor **270**.

In the electronic device **300** whose inside has a temperature higher than the operation guarantee temperature, the fan control part **354** makes the fan **353** rotate at a high speed based on a sensing result of the sensor **370** in order to make the inside temperature of the electronic device **300** equal to the operation guarantee temperature.

Therefore, the air flow U**2** generated inside of the electronic device **200** by the rotation of the fan **253** and sent to the electronic device **300** is smaller than an air flow U**3** generated inside of the electronic device **300** by the rotation of the fan **353**.

The first air intake and exhaust hole forming part **214** and the second air intake and exhaust hole forming part **230** are provided in the vicinity of a lower side of the fan installation part **390** of the electronic device **300** provided on the electronic device **200**.

Hence, air outside of the electronic device **200** which has a temperature lower than the inside of the electronic device **200** is taken in through the first air intake and exhaust hole forming part **214** and the second air intake and exhaust hole forming part **230**.

The outside air taken in through the first air intake and exhaust hole forming part **214** and the second air intake and exhaust hole forming part **230** is mixed with the air having an air flow U**2** generated inside of the electronic device **200** by the rotation of the fan **253** and sent to the electronic device **300** so as to be supplied to the electronic device **300** whose inside has a temperature higher than the operation guarantee temperature. As a result of this, the above-mentioned equation 1 is satisfied.

Thus, according to the method for cooling the communication equipment **1** of the present invention, in order to make the inside temperature of the electronic devices **100**, **200** and **300** equal to the operation guarantee temperatures, the fans **153**, **253** and **353** are rotated so that air having designated air flow is provided. Through the first air intake and exhaust hole forming parts **114**, **214**, and **314** and the second air intake and exhaust hole forming parts **130**, **230** and **330**, air outside of the electronic devices **100**, **200** and **300** is taken inside of the electronic devices **100**, **200** and **300**, or air inside of the electronic devices **100**, **200** and **300** is exhausted to outside of the electronic devices **100**, **200** and **300**. Because of this, air flows of the air ventilated (circulated) inside of the electronic devices **100**, **200** and **300** are controlled.

Therefore, because of control of the air flow by the first air intake and exhaust hole forming parts **114**, **214**, and **314** and the second air intake and exhaust hole forming part **130**, **230** and **330**, when the fan control parts **154**, **254** and **354** control the rotations of the fans **153**, **253** and **353** in order to keep the temperature sensed by the sensors **170**, **270** and **370** constant, rotating the fans **153**, **253** and **353** more than necessary cab be prevented. Therefore, it is possible to reduce consumption of electric power for the fans **153**, **253** and **353**.

Meanwhile, inventors of the present invention did two kinds of simulations and obtained the following results, in order to know proper positions and areas of the first air intake and exhaust hole forming areas **116**, **216**, and **316** where the first air intake and exhaust hole forming parts **114**, **214**, and **314** are formed and the second air intake and exhaust hole forming areas **131**, **231** and **331** where the second air intake and exhaust hole forming part **130**, **230** and **330** are formed; and proper numerical apertures of the first air intake and exhaust hole forming parts **114**, **214**, and **314** in the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming part **130**, **230** and **330** in the second air intake and exhaust hole forming areas **131**, **231** and **331**.

Here, as conditions for the simulation, measurement of the electronic device main parts **180**, **280** and **380** are set as having 235 mm as a vertical length, 541 mm as a horizontal length, and 118.5 mm as a height, and measurement of the fan installation parts **190**, **290** and **390** are set as having 235 mm as a vertical length, 541 mm as a horizontal length, and 458.5 mm as a height.

Furthermore, numerical apertures of the air intake hole forming parts **15**, **25** and **35** and the air exhaust hole forming parts **16**, **26** and **36** are set as 40%, and loss factors of the air intake hole forming parts **15**, **25** and **35** and the air exhaust hole forming parts **16**, **26** and **36** are set as 3.0.

In addition, the consumption of electric power by heating elements inside of the electronic devices **100**, **200** and **300**, and the rotations of the fans **153**, **253** and **353** are set as shown in the following table 1.

TABLE 1

	Electronic Device 100	Electronic Device 200	Electronic Device 300
Consumption of Electric Power By Heating Elements In Electronic Device [W]	34.5 × 20	17.25 × 20	34.5 × 20
Rotation of Fan	High Speed Rotation	Low Speed Rotation	High Speed Rotation

The inventors of the present invention did a first simulation, by setting constant 40% as the numerical apertures of the first air intake and exhaust hole forming parts **114**, **214**, and **314** in the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming part **130**, **230** and **330** in the second air intake and exhaust hole forming areas **131**, **231** and **331**, and changing positions and areas of the first air intake and exhaust hole forming areas **116**, **216**, and **316** where the first air intake and exhaust hole forming parts **114**, **214**, and **314** are formed and the second air intake and exhaust hole forming areas **131**, **231** and **331** where the second air intake and exhaust hole forming part **130**, **230** and **330** are formed as shown in FIG. **12**.

FIG. **12** is a view showing nine conditions (FIG. **12**-(*a*) through FIG. **12**-(*i*)) with regard to the positions and areas of the first intake and exhaust hole forming areas **116**, **216** and **316** and the second intake and exhaust hole forming areas **131**, **231** and **331** in the first simulation.

In the condition shown in FIG. **12**-(*a*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the upper half of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

In the condition shown in FIG. **12**-(*b*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the upper one third of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

In the condition shown in FIG. **12**-(*c*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the upper one fourth of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

In the condition shown in FIG. **12**-(*d*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the middle half of the front surface and back surface of the electronic device main parts **180**, **280** and **380** line-symmetrically with respect to a center part of the electronic device main parts **180**, **280** and **380** (shown by one point dotted line).

In the condition shown in FIG. **12**-(*e*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the middle one third of the front surface and back surface of the electronic device main parts **180**, **280** and **380** line-symmetrically with respect to a center part of the electronic device main parts **180**, **280** and **380** (shown by one point dotted line).

In the condition shown in FIG. **12**-(*f*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the middle one fourth of the front surface and back surface of the electronic device main parts **180**, **280** and **380** line-symmetrically with respect to a center part of the electronic device main parts **180**, **280** and **380** (shown by one point dotted line).

In the condition shown in FIG. **12**-(*g*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the lower half of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

In the condition shown in FIG. **12**-(*h*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the lower one third of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

In the condition shown in FIG. **12**-(*i*), the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the lower one fourth of the front surface and back surface of the electronic device main parts **180**, **280** and **380**.

Under the above-discussed conditions, the simulation was done and it is found that the temperature rises at upper parts, center parts, and lower parts of the electronic devices. FIG. **13** shows a table showing the results of the first simulation under the conditions shown in FIG. **12**.

Referring to FIG. **13**, under the conditions shown in FIG. **12**-(*b*) or FIG. **12**-(*c*), namely in the case where the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the upper one third through one fourth of the front surface and back surface of the electronic device main parts **180**, **280** and **380**, temperature increases of the electronic devices **100**, **200** and **300** are least and therefore the best cooling effect of the electronic devices **100**, **200** and **300** is obtained.

Under the conditions shown in FIG. **12**-(*g*) through FIG. **12**-(*i*), that is in the case where the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed at a lower side of the front and back surfaces, namely a side close to the fans **153**, **253** and **353**, since directivity of a current of air propelled from the fans **153**, **253** and **353** is strong, the propelled air spreads to the outside in the vicinity of the fans **153**, **253** and **353**. Therefore, air propelled from the fans **153**, **253** and **353** and having a high speed is blown out to the outside of the electronic devices **100**, **200** and **300** via the first air intake and exhaust hole forming parts **114**, **214** and **314** and the second air intake and exhaust hole forming parts **130**, **230** and **330** and therefore the cooling effect is degraded.

Next, the inventors did a second simulation, by setting the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** to be formed in an area occupying the upper one third of the front surface and back surface of the electronic device main parts **180**, **280** and **380**, as shown in FIG. **12**-(*b*), and changing the numerical apertures of the first air intake and exhaust hole forming parts **114**, **214**, and **314** in the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming part **130**, **230** and **330** in the second air intake and exhaust hole forming areas **131**, **231** and **331** to 0%, 10%, 20%, 30% and 40%.

As a result of the second simulation, temperature increases at the upper part, center part and lower part of the electric device main parts **180**, **280** and **380** as shown in FIG. **14** are found. Here, FIG. **14** shows a table showing the result of the second simulation.

Referring to FIG. **14**, under the conditions that the numerical apertures of the first air intake and exhaust hole forming parts **114**, **214**, and **314** in the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming part **130**, **230** and **330** in the second air intake and exhaust hole forming areas **131**, **231** and **331** are 20% through 40%, temperature increases of the electronic devices **100**, **200** and **300** are least and therefore best cooling effect on the electronic devices **100**, **200** and **300** is obtained. That is to say, if only minimizing the temperature increases inside of the electronic device main parts **180**, **280** and **380** is considered, it is preferable that the above-mentioned numerical aperture be made large.

However, it the numerical aperture is too large, shielding against leakage of the electromagnetic waves of the electronic devices **100**, **200** and **300** is made weak.

The inventors of the present invention realized that it is possible to make the temperature increases inside of the electronic device main parts **180**, **280** and **380** the least and effectively shield against leakage of the electromagnetic wave to the outside of the electronic devices **100**, **200** and **300**, by applying the structure shown in FIG. **15** to the punching metal parts **117** and **132** shown in FIG. **3** and others. Here, FIG. **15** is a perspective view showing a part of the punching metal parts **117** and **132**.

Referring to FIG. **15**, in the punching metal parts **117** and **132** each of which has a plate having a thickness of 2 mm, plural opening circles having diameters of 2 mm are formed in a state where center parts of the circles are offset to the side at 3 mm and 60 degrees.

Under this structure, in a case where the numerical aperture is 40.3%, that is, the opening parts are formed in the punching plate in a state where **115** opening circles are formed per a square having a side of a wave length, 30.2 dB of shielding effect for electromagnetic waves having a frequency of 10 GHz is obtained by the following equation 2.

$$\text{Shielding effect for electromagnetic waves having a frequency of 10 GHz}=20\log(f_c/f)+27.3(t/w)-10\log(n) \quad \text{[Equation 2]}$$

Here, "w" represents the diameter of the opening circle and is 2 mm in the example shown in FIG. **12**; "t" represents the thickness of the punching metal and is 2 mm in the example shown in FIG. **12**; "f" represents the frequency and is 10 GHz in the example shown in FIG. **12**; "f_c" represents a shield frequency and is 1.76×10^{11}/W=87.7 GHz in the example shown in FIG. **12**; and "n" represents the number of opening circles formed per a square having a side of a wave length λ (3×10^8/f=30 mm) and is **115** in the example shown in FIG. **12**.

Thus, in order to realize that it is possible to make the temperature increases inside of the electronic device main parts **180**, **280** and **380** the least and effectively shield against leakage of the electromagnetic waves to the outside of the electronic devices **100**, **200** and **300**, it is most preferable that the numerical aperture in the punching metal parts **117** and **132** be approximately 40%, for example.

Thus, under the conditions shown in FIG. **12**-(*b*) or FIG. **12**-(*c*), namely in the case where the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming areas **131**, **231** and **331** are formed in an area occupying the upper one third through one fourth of the front surface and back surface of the electronic device main parts **180**, **280** and **380**, and the numerical apertures of the first air intake and exhaust hole forming parts **114**, **214**, and **314** in the first air intake and exhaust hole forming areas **116**, **216**, and **316** and the second air intake and exhaust hole forming part **130**, **230** and **330** in the second air intake and exhaust hole forming areas **131**, **231** and **331** are 20% through 40%, it is possible to effectively shield against the leakage of the electromagnetic waves to outside of the electronic devices **100**, **200** and **300** and make the temperature increases of the electronic devices **100**, **200** and **300** the least and therefore the best cooling effect for the electronic devices **100**, **200** and **300** is obtained.

Therefore, under the above-discussed structure, in a case where the plug-in units **110** which are heating sources, are not installed fully inside of the electronic devices **100**, **200** and **300**, it is possible to reduce the number of rotations of the fans cooling the inside of the electronic devices **100**, **200** and **300** so that consumption of electric power of the fans can be efficiently reduced.

For example, in a case where the plug-in units **110** which are heating sources are fully installed inside of the electronic devices **100**, **200** and **300** and the fans **153**, **253** and **353** which consume electric power of 50W for cooling them are installed in the electric devices **100**, **200** and **300** but only half of the plug-in units **110** actually work, electric power of 150 W is consumed for driving the fans **153**, **253** and **353** in the conventional art. However, according to the present invention, only approximately 75 W is consumed and therefore it is possible to reduce consumption of the electric power.

The present invention is not limited to these embodiments, but variations and modifications may be made without departing from the scope of the present invention.

What is claimed is:

1. A cooling structure for electronic equipment including a plurality of electronic devices superposed on each other, each of the electronic devices having a lower part where an air ventilation part configured to ventilate air so as to coot the electronic device is provided, the cooling structure comprising:

an air intake and exhaust hole forming part which is formed at an upper part of a first one of the electronic devices and below the air ventilation part of a second one of the electronic devices provided on the first electronic device;

wherein air outside of the electronic equipment is taken into an inside of the second electronic device or air inside of the first electronic device is exhausted to the outside of the electronic equipment via the air intake and exhaust hole forming part, so that an amount of the air ventilated inside of the first electronic device is controlled.

2. The cooling structure as claimed in claim **1**,

wherein the electronic device includes an electronic device main part situated above the air ventilation part,

a cooling object of the air ventilation part is provided at the electronic device main part,

an air intake and exhaust hole forming area is formed in an area occupying an upper one third through one fourth of front and back surfaces of the electronic device main part, and

the air intake and exhaust hole forming part is formed in the air intake and exhaust hole forming area.

3. The cooling structure as claimed in claim **2**,

wherein a numerical aperture of the air intake and exhaust hole forming part in the air intake and exhaust hole forming area is 20% through 40%.

4. The cooling structure as claimed in claim **2**,

wherein an electromagnetic wave shielding member, configured to shield against the leakage of an electromagnetic wave to the outside of the electronic device, is provided in the air intake and exhaust hole forming area.

5. The cooling structure as claimed in claim **1**,

wherein the electronic device includes an electronic device main part situated above the air ventilation part,

a cooling object of the air ventilation part is provided at the electronic device main part,

an air intake and exhaust hole forming area is formed in an area occupying an upper one third through one fourth of a side surface of the electronic device main part, and

the air intake and exhaust hole forming part is formed in the air intake and exhaust hole forming area.

6. The cooling structure as claimed in claim **5**,

wherein a numerical aperture of the air intake and exhaust hole forming part in the air intake and exhaust hole forming area is 20% through 40%.

7. The cooling structure as claimed in claim **5**,

wherein an electromagnetic wave shielding member, configured to shield against the leakage of an electromagnetic wave to the outside of the electronic device, is provided in the air intake and exhaust hole forming area.

8. The cooling structure as claimed in claim **1**,

wherein the electronic device further includes:

a temperature sensing part configured to sense a temperature inside of the electronic device; and

an air ventilation control part configured to control an operation of the air ventilation part, so that the temperature of the inside of the electronic device sensed by the temperature sensing part becomes equal to a designated operation guarantee temperature.

9. The cooling structure as claimed in claim **8**,

wherein the air ventilation part is a fan,

the air ventilation control part increases the number of rotations of the fan when the temperature of an inside of the electronic device is higher than the operation guarantee temperature, and

the air ventilation control part decreases the number of rotations of the fan when the temperature of the inside of the electronic device is lower than the operation guarantee temperature.

10. The cooling structure as claimed in claim **8**,

wherein the temperature sensing part is provided on an upper part of the electronic device, and senses a temperature of inside air of the electronic device.

11. The cooling structure as claimed in claim **8**,

wherein the temperature sensing part is fixed to an electronic part provided inside of the electronic device, and senses a temperature of the electronic part.

12. A cooling method for electronic equipment including a plurality of electronic devices superposed on each other, a first one of the electronic devices having a structure where an air intake and exhaust hole forming part is formed at an upper part of the first electronic device, the electronic equipment being cooled by ventilating air into or out of the electronic devices, the cooling method comprising the step of:

controlling the ventilation of the air in the first electronic device by taking air outside of the electronic equipment into an inside of a second one of the electronic devices superposed on the first electronic device via the air intake and exhaust hole forming part or exhausting air inside of the first electronic device to the outside of the electronic equipment via the air intake and exhaust hole forming part, so that the temperature of the inside of the first electronic device sensed by a temperature sensing part becomes equal to a designated operation guarantee temperature.

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